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October 21, 1997

Mr. Stein M. Buer
CALFED Bay-Delta Program
1416 Ninth Street, Suite 1155
Sacramento, CA 95814

Subject: Artificial Neural Network model: Calibration and implementation

Dear Mr. Buer:

We understand that work is currently underway to incorporate the Artificial Neural Networks (ANNs) into DWRSIM and have reviewed the DWR's recent report to the SWRCB titled "Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh" (18th Annual Report, June 1997). Before CALFED considers using an ANN-based DWRSIM model, we believe that the ANN algorithm would need to be rigorously tested and verified against field data.

Presumably, the reason that the ANN or any multi-component flow-salinity model is being considered as an alternative to the G-model or the MDO routine is that with the increase in model complexity a substantial improvement in the prediction of field data is gained. However, based on Figures 3-1 through 3-4 in this report, where multi-component (but non-NDO) ANN versions are compared to single component (NDO only) ANN versions, there does not seem to be a significant improvement. Furthermore, we believe that these figures suggest NDO, more than any other quantity or combination of quantities, influences the salinity in the western and central Delta and should be the primary variable around which the ANNs are developed. If additional variability is identified, additional variables such as QWEST/NDO, exports, precipitation, etc. could be included.

We assume that ANN models and other multi-variable regression models will be much more effective if the input data are selected using physically-based reasoning. Using input data that are highly covariant (for example, cross-channel gate settings and Sacramento River inflow) could confuse even the "smartest" of multi-variable regression models.

We also understand from our review of this report that the ANN model is calibrated on output from DSM rather than actual field data "to create additional training data to negate the bias present in the historic data." We understand that the statement probably refers to the prediction problems at Rock Slough (page 84) but the implications of the statement are worrisome.

As discussed in our October 6, 1997 letter to you, there seem to be inconsistencies between the various salinity transport models and historical data. It would not be advisable to disregard historical data and rely on simulation model output. If the DSM or Fischer Model have a different response to cross-channel closures than actual field data, then that error would be perpetuated in the ANN model.

Also, we would like to openly discuss the statement, "models which use only NDO have more difficulty than multiple-input models in handling the non-historical operation of the Delta as proposed in various planning studies (page 85)." Admittedly, the G-model may not accurately predict salinity if Delta operations or channel configuration are substantially altered. But wouldn't all models calibrated on historical data or data from simulations of historical operations have the same problems if used to predict salinity in regimes outside of their calibration? And couldn't all models be calibrated with data from simulations of planned operations (if accurate) to predict salinity in the planned regime?

Lastly, it is sensible to calibrate against real data but we also need to be selective in which real data we use. For example, the models should not be calibrated using the Rock Slough chlorides during 1977 when the chlorides were kept artificially low using barriers and Mokelumne Aqueduct transfers, or data from the Andrus Island break in 1972 because we are not able to accurately estimate net Delta outflow during that period.

We look forward to discussing modeling issues with you and your technical staff. If you have any questions please call me at (510) 688-8187.

Sincerely,

Richard Denton
Water Resources Manager

DAB

cc: Gregory Gartrell
David Briggs

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